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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/730,295	12/08/2003	Kyeong Keun Choi	29936/39864	2190
4743	7590	06/24/2005	EXAMINER	
MARSHALL, GERSTEIN & BORUN LLP 233 S. WACKER DRIVE, SUITE 6300 SEARS TOWER CHICAGO, IL 60606			BLUM, DAVID S	
			ART UNIT	PAPER NUMBER
			2813	

DATE MAILED: 06/24/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

82

Office Action Summary	Application No. 10/730,295	Applicant(s) CHOI, KYEONG KEUN	
	Examiner David S. Blum	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 is/are pending in the application.
4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-16 and 18 is/are rejected.
- 7) ☒ Claim(s) 17 is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>12/6/03</u> <u>4/11/05</u> | 6) <input type="checkbox"/> Other: ____ |

Art Unit: 2813

This action is in response to the application filed 12/8/03.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-2, 15, and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by Liang (US005972758A).

Liang teaches the all of the positive steps of claims 1-2, 15, and 18 as follows.

Regarding claim 1, Liang forms a trench which is wider on the bottom than a top in a given region of a semiconductor substrate (figure 2b), buries the trench with an insulating layer (212) while forming empty spaces (air gaps 214, column 3 line 20) by using a coverage characteristic of the insulating material (air gaps are formed during the filling step, thus a coverage characteristic of the insulating material is used.

Regarding claim 2, a mask pattern is formed on the substrate (patterned 302), the substrate is etched to a given depth by a first etch process (figure 3B), a second etch forms the trench in a vertical and horizontal direction so that the bottom is wider than the top (figure 3E), and the mask pattern is removed (figure 3H).

Art Unit: 2813

Regarding claim 15, the first and second etch processes are performed repeatedly to form the trench to a target depth (as per the specification, if the desired depth is not reached, the etch steps may be repeated until the desired depth is reached. As Liang has reached the desired depth, this reads on "repeatedly to form the trench to a target depth).

Regarding claim 18, prior to burying the trench a SiN thin film is deposited on the substrate (308) including an inner surface of the trench (SiN 310).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liang (US005972758A) in view of Wolf (volume 2 page 53).

Liang teaches all of the positive steps of claim 3 as recited above in regard to claim 2, except for a polymer being deposited on the sidewall of the trench and serving as an anti-etch film at the time of the second etch. Liang is silent as to for a polymer being deposited on the sidewall of the trench and serving as an anti-etch film at the time of the second etch. However, Wolf (page 53) teaches that the etching of the silicon oxide

Art Unit: 2813

mask (photoresist on the silicon oxide to pattern it) will deposit polymer on the trench wall during the etching of the silicon. As the positive steps are identical, the same functional result would occur.

A claim containing a "recitation with respect to the manner in which a claimed apparatus (in this case the apparatus is a polymer film) is intended to be used does not differentiate the claimed apparatus from the prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987) MPEP 2114.

Regarding claim 6, the first and second etch processes are performed repeatedly to form the trench to a target depth (as per the specification, if the desired depth is not reached, the etch steps may be repeated until the desired depth is reached. As Liang has reached the desired depth, this reads on "repeatedly to form the trench to a target depth).

5. Claims 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liang (US005972758A) in view of Wolf (volume 2 page 53) and in further view of Lin (US006716757B2) and Sugishima (US4352724).

Liang and Wolf teach all of the positive steps of claims 4 and 5 as recited above in regard to claim 3, except for the specific etch processes.

Regarding claim 4, Liang is silent as to how the first etch is performed. Lin teaches a method for forming a trench where the bottom is larger than the top. Although the

Art Unit: 2813

method differs from the method of the instant application, the first etch in both Lin and the instant application forms a conventional trench. Lin does this by plasma or RIE (reactive ion etching column 3 lines 12-15). Lin is silent as to the etch gas or the power. Sugishima teaches reactive ion etching of silicon and polysilicon using a gas containing chlorine (Table II.2) and at 1000 Watts (column 4 lines 45-51). Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

Regarding claim 5, Liang teaches the second etch process may be either wet or dry etch, or a combination of the two (column 4 lines 5-7), but does not teach specific etch chemistries. Sugishima teaches isotropic wet etching of silicon and polysilicon using a solution of HF-HNO₃ (a solution is in water thus H₂O is also present, Table I.1). Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Liang and Wolf by including conventional etching processes and chemistries as taught by Lin and Sugishima to save both time and money rather than have the expenditure of research.

6. Claims 7-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liang (US005972758A) in view of Lin (US006716757B2).

Liang teaches all of the positive steps of claim 7 as recited above in regard to claim 2, except for the specific etch processes.

Regarding claim 7, Liang is silent as to the first etch, but teaches the second etch to be either wet or dry. Lin teaches a method for forming a trench where the bottom is larger than the top. Although the method differs from the method of the instant application, the first etch in both Lin and the instant application forms a conventional trench. Lin does this by plasma or RIE (reactive ion etching column 3 lines 12-15), RIE being a dry process and used in the instant specification.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Liang by including conventional etching processes and chemistries as taught by Lin to save both time and money rather than have the expenditure of research.

7. Claims 8-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liang (US005972758A) in view of Lin (US006716757B2) and Sugishima (US4352724).

Art Unit: 2813

Liang teaches all of the positive steps of claims 8-10 as recited above in regard to claim 7 and claims 11-14 as recited above in regard to claim 2, except for the specific etch processes.

Regarding claim 7, Liang is silent as to how the first etch is performed. Lin teaches a method for forming a trench where the bottom is larger than the top. Although the method differs from the method of the instant application, the first etch in both Lin and the instant application forms a conventional trench. Lin does this by plasma or RIE (reactive ion etching column 3 lines 12-15). Lin is silent as to the etch gas or the power. Sugishima teaches reactive ion etching of silicon and polysilicon using a gas containing chlorine (Table II.2) and at 1000 Watts (column 4 lines 45-51). Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

Regarding claim 9, Liang teaches the second etch process may be either wet or dry etch, or a combination of the two (column 4 lines 5-7), but does not teach specific etch chemistries. Sugishima teaches isotropic wet etching of silicon and polysilicon using a solution of HF-HNO₃ (a solution is in water thus H₂O is also present, Table I.1). Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

Regarding claim 10, the first and second etch processes are performed repeatedly to form the trench to a target depth (as per the specification, if the desired depth is not reached, the etch steps may be repeated until the desired depth is reached. As Liang has reached the desired depth, this reads on "repeatedly to form the trench to a target depth).

Regarding claim 11, Liang is silent as to how the first etch is performed. Lin teaches a method for forming a trench where the bottom is larger than the top. Although the method differs from the method of the instant application, the first etch in both Lin and the instant application forms a conventional trench. Lin does this by plasma or RIE (reactive ion etching column 3 lines 12-15). Lin is silent as to the etch gas or the power. Sugishima teaches reactive ion etching of silicon and polysilicon using a gas containing chlorine (Table II.2) and at 1000 Watts (column 4 lines 45-51). Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

Regarding claim 12, the first and second etch processes are performed repeatedly to form the trench to a target depth (as per the specification, if the desired depth is not reached, the etch steps may be repeated until the desired depth is reached. As Liang

Art Unit: 2813

has reached the desired depth, this reads on "repeatedly to form the trench to a target depth).

Regarding claim 13, Liang teaches the second etch process may be either wet or dry etch, or a combination of the two (column 4 lines 5-7), but does not teach specific etch chemistries. Sugishima teaches isotropic wet etching of silicon and polysilicon using a solution of HF-HNO₃ (a solution is in water thus H₂O is also present, Table I.1).

Sugishima teaches these listed etchants to be known, and one skilled in the requisite art would use known etchants and processes to save both time and money rather than have the expenditure of research.

Regarding claim 14, the first and second etch processes are performed repeatedly to form the trench to a target depth (as per the specification, if the desired depth is not reached, the etch steps may be repeated until the desired depth is reached. As Liang has reached the desired depth, this reads on "repeatedly to form the trench to a target depth).

It would be obvious to one skilled in the requisite art at the time of the invention to modify Liang and Wolf by including conventional etching processes and chemistries as taught by Lin and Sugishima to save both time and money rather than have the expenditure of research.

Art Unit: 2813

8. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liang (US005972758A) in view of Tanaka (US006841452B2) and Wolf (volume 2 page 198).

Liang teaches all of the positive steps of claim 16 as recited above in regard to claim 1, except for filling the trench using TEOS at a temperature range of 300-500 degrees C.

Regarding claim 16, Liang is silent as to how the trenches are filled, only teaching "the trench is then filled with an oxide of silicon using a conventional trench filling process.", and "By leaving an air gap" (column 4 lines 35-40). Tanaka forms trenches that are wider at the bottom than the top, fills them with a CVD oxide using TEOS leaving air gaps along the bottom where the oxide is hard to grow (column 2-line 65-column 3 line 5). Tanaka however is silent as to the deposition temperature. Wolf (page 198) teaches that it is known to deposit silicon oxide from TEOS at a temperature of about 375 degrees C.

It would be obvious to one skilled in the requisite art at the time of the invention to modify Liang by depositing silicon oxide from TEOS as taught by Tanaka to leave air gaps along the bottom of the trench corners where the oxide is hard to grow (column 2-line 65-column 3 line 5), the air gaps being a desired effect in both Liang and Tanaka.

Allowable Subject Matter

9. Claim 17 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim 17 limits the filling of the trench where the insulating layer is formed using a SOD or SOG oxide film, while the insulating film is not formed at both corners of the bottom of the trench due to a coverage characteristic of a spin coating oxide film. This limitation, in combination with the other limitations of claim 17 is not taught or suggested by the prior art of record. Liang (US005972758A), Lin (US006716757B2), and Tanaka (US006841452B2) all form trenches with bottoms wider than the top and fill the trenches so that the insulating film is not formed at both corners of the bottom of the trench, but none of the cited references teach or suggest the use of a spin on material. Although it is known to fill trenches with spin on materials, none of the cited art teaches this in reference to forming gaps as in the instant claim.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (571)-272-1687) and e-mail address is David.blum@USPTO.gov .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr., can be reached at (571)-272-1702. Our facsimile number all patent correspondence to be entered into an application is (703) 872-9306. The facsimile number for customer service is (703)-872-9317.

Art Unit: 2813

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "David S. Blum", with a long horizontal flourish extending to the right.

David S. Blum

June 21, 2005